

I claim:

- 1 1. A mass analyzer comprising an electron source, the electron source including:
2 an electron filament coupled to an electrical supply, the electron filament
3 including a conductive wire or conductive ribbon, and the electron
4 filament configured to generate electrons when heated;
5 a plurality of nanofilaments disposed on the surface of the electron
6 filament; and
7 a filament body for positioning the electron filament relative to a mass
8 filter.
- 1 2. The mass analyzer of claim 1, wherein the electron filament is configured to
2 generate electrons when heated in an electric field of less than 70 volts
3 per centimeter.
- 1 3. The mass analyzer of claim 1, wherein the electron filament is configured to
2 generate electrons when heated in an electric field of less than 50 volts
3 per centimeter.
- 1 4. The mass analyzer of claim 1, wherein the electron filament is configured to
2 generate electrons while a background pressure in the source is greater
3 than 1.0×10^{-4} Torr.

1 5. The mass analyzer of claim 1, wherein the electron filament is configured to
2 generate electrons while a background pressure in the source is greater
3 than 1.0×10^{-5} Torr.

1 6. A mass analyzer comprising an electron source, the electron source including:
2 an electron filament coupled to an electrical supply configured to pass a
3 current through the electron filament;
4 a plurality of nanofilaments disposed on the surface of the electron
5 filament;
6 a filament body for positioning the electron filament relative to a mass
7 filter; and
8 means for directing electrons generated using the electron filament.

1 7. The mass analyzer of claim 6, wherein the means for directing electrons is a
2 magnetic field.

1 8. The mass analyzer of claim 6, wherein the electron source is configured such
2 that the directed electrons are accelerated to an energy of approximately
3 70 electron volts.

1 9. The mass analyzer of claim 6, wherein the nanofilaments include carbon
2 nanotubes.

1 10. The mass analyzer of claim 6, wherein the nanofilaments include boron.

- 1 11. The mass analyzer of claim 6, wherein the electron source is
2 configured to generate electrons for electron capture ionization.
- 1 12. The mass analyzer of claim 6, wherein the electron source is configured to
2 generate electrons for electron impact ionization.
- 1 13. The mass analyzer of claim 6, wherein the electron source is configured to
2 generate electrons for chemical ionization.
- 1 14. The mass analyzer of claim 6, wherein the electron source is configured to
2 generate electrons for ion fragmentation.
- 1 15. The mass analyzer of claim 6, wherein the electron filament is a ribbon or
2 wire.
- 1 16. The mass analyzer of claim 6, further including a mass filter.
- 1 17. The mass analyzer of claim 6, further including a sample source.
- 1 18. A filament assembly comprising:
2 an electron filament coupled to an electrical supply configured to provide a
3 current through the electron filament and to hold the electron
4 filament at a potential relative to part of an electron source;
5 a plurality of nanofilaments disposed on the surface of the electron
6 filament; and

7 means for positioning the electron filament.

1 19. The filament assembly of claim 18, wherein the electron filament is a wire or
2 a ribbon.

1 20. The filament assembly of claim 18, wherein the potential is approximately 70
2 Volts..

1 21. An analysis system comprising:

2 an electron filament coupled to an electrical supply configured to pass a
3 current through the electron filament and to hold the electron
4 filament at a potential of approximately 70 Volts relative to an other
5 part of the analysis system, the electron filament including a
6 conductive wire or conductive ribbon, the electron filament
7 configured to generate electrons when heated;

8 a plurality of nanofilaments disposed on the surface of the electron
9 filament;

10 a filament body for positioning the electron filament relative to the other
11 part of the analysis system;

12 means for directing electrons generated using the electron filament;

13 a mass filter configured to filter ions generated using the generated
14 electrons; and

15 an ion detector configured to detect the filtered ions.

1 22. The analysis system of claim 21, further including a chromatograph
2 configured to introduce a sample to the mass filter.

1 23. The analysis system of claim 21, further including a second mass filter
2 configured to introduce a sample to the mass filter configured to filter ions
3 generated using the generated electrons.

1 24. A method of analyzing a sample comprising:
2 generating electrons with energy of approximately 70eV, using an electron
3 filament coupled to an electrical supply configured to pass a current
4 through the electron filament and to hold the electron filament at an
5 approximate potential, the electron filament including a conductive
6 wire or conductive ribbon, the electron filament further including a
7 plurality of nanofilaments disposed on the surface of the electron
8 filament;
9 causing the generated electrons to contact the sample;
10 ionizing the sample using the generated electrons, to produce ions;
11 separating the produced ions; and
12 detecting the separated ions.

13 25. The method of claim 24, wherein the separation ions are separated in time.

1 26. The method of claim 24, wherein the produced ions are produced using
2 chemical ionization.

1 27. The method of claim 24, further including maintaining a background pressure
2 greater than 1×10^{-5} Torr.

1 28. A method of analyzing a sample comprising:
2 generating electrons using an electron filament coupled to an electrical
3 supply configured to pass a current through the electron filament
4 and to hold the electron filament at an approximate potential, the
5 electron filament including a conductive wire or conductive ribbon,
6 the electron filament further including a plurality of nanofilaments
7 disposed on the surface of the electron filament;
8 causing the generated electrons to contact an ion;
9 fragmenting the ion using the generated electrons, to produce an ion
10 fragment;
11 filtering the produced ion fragment; and
12 detecting the filtered ion fragment.

1 29. The method of claim 28, further including generating the ion using a mass
2 filter.

1 30. The method of claim 28, wherein the generated electrons are caused to
2 contact the ion in a region with a background pressure of greater than $1 \times$
3 10^{-4} Torr.

1 31. A filament assembly comprising:

2 an electron filament configured to be coupled to an electrical supply for
3 providing a current through the electron filament and for holding the
4 electron filament at a potential relative to part of an electron source;
5 and
6 a plurality of nanoparticles disposed within the electron filament.

1 32. The filament assembly of claim 31, wherein the nanoparticles are configured
2 to modify grain boundaries within the electron filament.

1 33. The filament assembly of claim 31, wherein the nanoparticles include
2 polyhedral oligomeric silsesquioxane.

1 34. The filament assembly of claim 31, wherein the nanoparticles include a
2 silicon compound of the chemical composition shown in FIG. 7.

1 35. The filament assembly of claim 31, wherein the nanoparticles include a
2 silicon compound of the chemical structure shown in FIG. 7.

1 36. The filament assembly of claim 31, further including means for positioning the
2 electron filament relative to a mass filter.

1 37. The filament assembly of claim 31, wherein the potential relative to part of an
2 electron source is approximately 70 Volts.

1 38. The filament assembly of claim 31, further including means for positioning the
2 electron filament relative to an electron gun.